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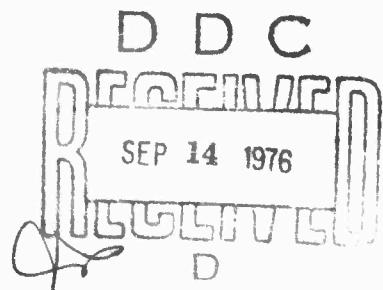


USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

VOLUME 60 UH-1N IN-FLIGHT CREW NOISE

NOVEMBER 1975

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AEROSPACE MEDICAL RESEARCH LABORATORY
AEROSPACE MEDICAL DIVISION
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio 45433

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FOR THE COMMANDER


HENNINGE VON GIERKE
Director
Biodynamics and Bionics Division
Aerospace Medical Research Laboratory

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The UH-1N is a USAF Utility helicopter configured as a gunship. This report provides measured data defining the bioacoustic environments at flight crew locations inside this helicopter during normal flight operations. Data are reported for one location in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise level, and limiting times for total daily exposure of personnel with and without		

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standard Air Force ear protectors. Refer to Volume 1 of this handbook, "USAF Bioenvironmental Noise Data Handbook, Vol 1: Organization, Content and Application", AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc.

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PREFACE

This report was prepared by the Biodynamic Environment Branch, Aerospace Medical Research Laboratory, under Project/Task 72310418, Measurement of Noise and Vibration Environments of Air Force Operations. Col Justus F. Rose, Jr. conducted the field measurements and performed the data analysis; Capt Nick Farinacci prepared this report.

The authors acknowledge the efforts of Mr. John N. Cole who established the data analysis requirements and assisted in the preparation of this report, and Mr. Henry Mohlman and Mr. David Eilerman of the University of Dayton who assisted in the mechanics of data processing.

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INTRODUCTION

The UH-1N is a USAF utility helicopter configured as a gunship and manufactured by the Bell Helicopter Company. Power is provided by two T400-CP-400 (PT6T-3) turboshaft engines rated at 1,800 shp at 6,600 rpm maximum take-off power. Both engines drive a two-blade 14.69 m main rotor and a two-blade 2.59 m diameter tail rotor. The engines are manufactured by the United Aircraft Corporation, United Aircraft of Canada, Ltd.

This volume provides measured data defining the bioacoustic environments produced inside this helicopter. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the UH-1N helicopter.

This volume is one of a series published by the Aerospace Medical Research Laboratory (AMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and aerospace ground equipment. The far-field, community-type, noise data in the handbook describe the noise produced during *ground operations* of aircraft, aerospace ground equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. *Refer to Volume 1* (reference 1) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., in-flight/flight crew and passenger noise, near-field/ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published, and is available upon request from AMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of the updated index as it is generated.

Direct any questions concerning the technical data in this report and other handbook volumes to: AMRL/BBE, Wright-Patterson AFB, OH 45433; Autovon 78-53675 or 78-53664; Commercial (513) 255-3675 or (513) 255-3664.

1. Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application*, AMRL-TR-75-50 (1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

IN-FLIGHT NOISE

MEASUREMENTS

All noise measurements were made on-board a standard-configured UH-1N helicopter during typical speed, altitude, and flight maneuver conditions. These levels describe the standard UH-1N environments, but may not be representative of those levels encountered if the aircraft has been configured differently (e.g., major equipment or structural changes).

Acoustic measurements were made at one flight crew location with the right and left rear doors open. Table 1 lists the measurement location and test conditions as numeric/alphabetic designators which are used on the data pages. The designator 1/A means measurement location 1 and test condition A.

The microphone was randomly moved external to the headgear in a region 0.2-0.3 meter from the head and the resultant samples analyzed using a 4- or 8-second integration time to obtain a power-averaged level that effectively smooths out short-duration fluctuations and best describes the exposure.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the UH-1N helicopter at the specified location. This table includes the overall, 1/3 octave band, and octave band levels. From these data, C-weighted and A-weighted sound levels, maximum permissible time for one exposure per day (AFR 161-35) with and without standard Air Force ear protectors, preferred speech interference level, and perceived noise level are calculated and presented in Table 3. These measures are widely used to assess the effects of noise on personnel and their performance.

TABLE 1
MEASUREMENT LOCATION AND TEST CONDITIONS

LOCATION	POSITION	HEIGHT ABOVE DECK
1	Between Pilot and Copilot	Seated Head Level
CONDITION*	DESCRIPTION	
A	Ground power unit operating.	
B	#1 engine start, ground power unit operating.	
C	#2 engine start, #1 engine running, ground power unit operating.	
D	Engine RPM — 80%, Engine torque 10%, transmission torque 20% (will be shown as 10/20).	
E	Taxi (in ground effect) — 90% RPM, 25/50.	
F	Takeoff — 92% RPM, 35/70.	
G	Cruise — 90 KIAS, 90%, 25-50, 600' Altitude.	
H	Cruise (blade slap) — 70 KIAS, 90%, 20-40, 800' altitude.	
I	Cruise (blade slap) — 80 KIAS, 88%, 22-44, 800' altitude.	
J	Gunnery (7.62 mm minigun) — 2000 rounds/min — 80 KIAS, 90%, 30' 60.	
K	Left rocket pod firing (2 rockets) — 110 KIAS, 70%, 0/0, Descent to target.	
L	Left rocket pod firing — same conditions as K.	
M	Gunnery (7.62 mm minigun) — 100 KIAS, 90%, 30' 60.	
*	Right and left rear door open during all measurements.	

TABLE 1 (Continued)

MEASUREMENT LOCATION AND TEST CONDITIONS

UH-1N, Eglin AFB, 4 Aug 1971
Serial # 69-6605

<i>CONDITION*</i>	<i>DESCRIPTION</i>
N	Right rocket pod firing — 90 KIAS, 90%, 30/60.
P	Right rocket pod firing (2 rockets)— gunnery (7.62 mm minigun), 80 KIAS, 90%, 25/50.
Q	Gunnery (7.62 mm minigun) — firing rate 2000 rounds/min., 90 KIAS, 90%, 25/50, 300' altitude.
R	Same as Q — firing rate 4000 rounds/min.
S	Gunnery pass (7.62 mm minigun) — Forward to aft gun swing, 90 KIAS, 90%, 25/50.
T	Rocket and gunnery pass (3 rockets) — firing rate 2000 rounds/min., 100-120 KIAS, 90%, 30/60.
U	Descent and Landing, 90%, 30/60.

* Right and left rear door open during all measurements.

TABLE 1 MEASURED SOUND PRESSURE LEVEL (DB)
2
 1/3 OCTAVE BAND

NOISE SOURCE/SUBJECT	OPERATION	LOCATION/CONDITION										PAGE	F1	
		1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I	1/J			
FREQ (HZ)	MIN	MAX												
25	67	76	94	95	100	104	107	114	110	111	116			
31.5	73	75	97	99	101	106	107	109	106	108	110			
40	71	72	94	99	94	93	96	106	106	103	105			
50	71	77	93	94	96	99	101	101	99	98	103			
63	68	74	89	93	97	100	98	99	101	101	113			
80	84	75	68	92	94	99	93	100	100	99	111			
100	87	83	87	86	96	95	93	97	97	95	102			
125	71	75	79	82	94	91	88	92	92	90	105			
160	74	76	81	83	93	96	92	90	97	89	114			
200	76	77	83	85	95	96	90	90	90	96	90			
250	76	79	83	85	92	94	87	89	91	88	116			
315	73	76	78	81	91	91	84	87	88	86	115			
400	66	77	82	81	91	91	84	87	88	86	114			
500	70	77	81	84	89	90	84	87	87	86	115			
630	68	77	78	82	90	91	89	90	89	89	117			
800	67	73	87	84	86	90	85	86	86	86	118			
1000	63	70	81	90	86	87	85	87	85	86	115			
1250	62	68	76	79	85	85	83	86	83	84	117			
1600	64	66	77	79	91	90	88	89	86	87	116			
2000	64	68	75	82	83	83	81	86	82	84	121			
2500	60	65	74	79	81	81	79	83	83	82	117			
3150	57	65	73	77	84	84	81	83	80	82	116			
4000	57	65	74	79	80	79	78	81	76	80	117			
5000	53	63	76	79	76	76	75	78	75	77	115			
6300	51	65	84	83	81	78	77	78	76	77	114			
8000	53	60	82	86	83	80	80	82	82	82	114			
10000	49	58	69	77	84	86	86	81	80	81	110			
12500	45	60	67	73	87	81	80	80	79	80	110			
16000	45	59	67	73	83	79	78	79	79	79	109			
OVERALL		90	89	102	105	106	111	111	116	114	114	130		

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE 2 MEASURED SOUND PRESSURE LEVEL (DB)

NOISE SOURCE/SUBJECT:	MEASURED SOUND PRESSURE LEVEL (DB)						IDENTIFICATION:					
	OPERATIONS			TEST 71-014-061			OMEGA 3-2	RUN 02				
UM-1N HELICOPTER	10 JAN 75						10 JAN 75					
INFIGHT NOISE LEVELS							PAGE F2					
	FREQ (HZ)	1/K	1/L	1/M	1/N	1/P	LOCATION/CONDITION	1/Q	1/S	1/T	1/U	
25	112	114	117	110	110	110	113	114	112	113	107	
31.5	110	114	115	107	108	117	109	115	112	112	107	
40	105	106	111	104	103	115	109	113	105	105	102	
50	103	104	104	105	101	103	105	103	104	104	98	
63	104	109	111	104	105	110	119	111	107	101		
80	108	111	110	107	110	110	114	112	108	108		
100	103	106	111	108	107	116	115	116	113	113	96	
125	98	105	106	99	101	111	121	112	106	106	90	
160	98	105	111	100	102	114	115	114	105	105	93	
200	100	106	113	105	105	115	123	117	106	106	96	
250	96	105	112	107	107	116	116	113	106	106	90	
315	101	110	114	107	106	117	117	115	111	111	89	
400	102	109	117	109	108	120	119	116	113	113	86	
500	102	113	117	106	106	120	117	116	113	113	89	
630	108	115	117	113	109	121	123	117	115	115	86	
800	107	116	110	113	106	123	123	120	114	114		
1000	111	119	115	114	109	116	123	119	113	113	86	
1250	106	120	117	112	106	120	120	117	113	113	84	
1600	113	123	117	114	109	119	124	116	116	116	95	
2000	110	121	117	116	110	121	124	119	116	116	83	
2500	110	122	115	116	110	116	121	116	115	115	81	
3150	108	120	114	116	108	117	118	116	114	114	82	
4000	109	122	115	117	107	119	119	116	114	114	79	
5000	109	121	113	115	105	114	117	114	112	112	76	
6300	110	121	112	115	106	115	117	113	111	111	76	
8000	111	122	112	115	106	114	116	113	112	112	63	
10000	107	119	109	111	103	111	113	111	106	106	79	
12500	107	120	109	112	99	111	112	110	106	106	79	
16000	105	116	107	111	100	109	110	106	107	107	77	
OVERALL	122	132	129	127	121	132	134	130	126	126	112	

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)
2 OCTAVE BAND

2 NOISE SOURCE/SUBJECT: OPERATIONS:

UH-1N HELICOPTER
INFLIGHT NOISE LEVELS

FREQ (HZ)	LOCATION/CONDITION						1/H	1/I	1/J
	1/A	1/8	1/8	1/C	1/D	1/E			
31.5	76	79	101	103	104	108	110	116	113
63	84	80	95	96	101	104	103	105	105
125	87	84	88	90	100	99	96	98	101
250	61	82	87	89	97	98	92	93	93
500	73	62	85	87	95	95	91	93	92
1000	69	75	66	91	91	92	89	92	89
2000	67	71	60	65	92	91	69	92	88
4000	61	69	79	63	66	85	63	86	83
8000	56	67	66	89	89	66	67	84	85
16000	48	62	70	76	88	63	62	62	83
OVERALL	90	89	102	105	108	111	111	116	114
									130

IDENTIFICATION:
OMEGA 3.2
TEST 71-014-061
RUN 01
10 JAN 75
PAGE J1

TABLE I MEASURED SOUND PRESSURE LEVEL (dB)

FREQ (HZ)	1/K	1/L	1/M	1/N	1/P	1/Q	1/R	1/S	1/T	1/U	LOCATION/CONOITION	
											OPERATION:	TEST 71-014-051
31.5	114	117	119	113	112	120	116	118	116	111	OMEGA 3.2	TEST 71-014-051
63	110	113	114	110	109	113	120	115	111	105	RUN 02	TEST 71-014-051
125	105	111	115	104	109	119	123	120	114	98	10 JAN 75	TEST 71-014-051
250	104	112	118	111	111	121	125	120	114	98	PAGE J2	TEST 71-014-051
500	109	118	122	115	113	125	125	122	116	93		
1000	113	124	121	118	112	125	127	123	118	90		
2000	116	127	121	120	114	124	127	123	120	88		
4000	113	126	119	121	111	121	123	120	118	84		
8000	114	125	116	119	111	119	120	117	115	85		
16000	109	121	111	115	102	113	114	112	110	81		
OVERALL	122	132	129	127	121	132	134	130	126	112		

TABLE I MEASURES OF HUMAN NOISE EXPOSURE
3

NOISE SOURCE/SUBJECT: OPERATION:
 UH-1N HELICOPTER
 INFLIGHT NOISE LEVELS

	1/A	1/B	1/3	1/C	1/D	1/E	1/F	1/G	1/H	1/I	1/J
	MIN	MAX									

HAZARD/PROTECTION C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)											
NO PROTECTION											
OASLC	90	89	100	103	106	109	108	113	111	111	129
OASLA	77	82	92	95	98	95	95	96	96	96	128
T	960	679	120	71	42	42	71	42	60	60	P
HGU-2A/P HELMET WITH H-154											
OASLA*	74	75	81	84	91	91	86	88	91	87	115
T	960	960	807	480	143	143	339	240	143	285	2.2
HGU-2A/P HELMET WITH H-154(A)											
OASLA*	70	71	77	79	86	87	82	85	87	84	110
T	960	960	960	960	339	285	679	404	285	480	5
HGU-2A/P HELMET WITH CUSTOM LINER											
OASLA*	75	79	86	89	94	94	90	93	93	91	120
T	960	960	339	202	85	85	170	101	101	143	P
V-51R EAR PLUGS											
OASLA*	56	59	68	70	75	75	72	76	75	74	101
T	960	960	960	960	960	960	960	960	960	960	25
W-157 IN-FLIGHT COMMUNICATION UNIT											
OASLA*	68	67	74	76	83	84	80	83	85	82	106
T	960	960	960	960	571	480	960	571	404	679	11
COMMUNICATION PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)											
PSIL	70	76	85	88	93	93	90	92	90	90	122

ANNOYANCE
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)
TONE CORRECTION (C IN DB)

PNLT	96	109	111	115	114	112	112	113	112	113	143
C	2	1	3	3	2	2	0	1	1	1	1

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.
P ADDITIONAL EAR PROTECTION REQUIRED.

TABLE : MEASURES OF HUMAN NOISE EXPOSURE

3

NOISE SOURCE/SUBJECT : OPERATIONS

UH-1N HELICOPTER

INFLIGHT NOISE LEVELS

1/K 1/L 1/M 1/N 1/P 1/Q 1/R 1/S 1/T 1/U

HAZARD/PROTECTION
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DB) AT EAR
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)

NO PROTECTION	OASLC	121	131	128	126	120	131	133	130	126	110
OASLA	121	132	127	126	119	130	132	128	125	125	96
T	P	P	P	P	P	P	P	P	P	P	60
HGU-2/A/P HELMET WITH H-154	106	118	113	112	106	116	118	115	111	111	90
OASLA*	1.1	P	3.2	3.8	1.1	P	P	P	2.2	4.5	170
HGU-2/A/P HELMET WITH H-154(A)	98	107	108	103	100	112	114	110	105	105	86
OASLA*	42	9	8	18	30	3.8	2.7	5	1.3	3.39	
T											
HGU-2/A/P HELMET WITH CUSTOM LINER	112	122	120	116	112	124	126	122	117	117	93
OASLA*	3.8	P	P	P	3.8	P	P	P	P	P	101
V-51K EAR PLUGS	93	103	101	98	93	105	106	102	98	98	74
OASLA*	101	18	25	42	101	13	11	21	4.2	4.2	960
T											
H-157 IN-FLIGHT COMMUNICATION UNIT	96	107	105	101	97	108	110	106	102	102	84
OASLA*	60	9	13	25	50	8	5	11	21	21	480
T											

COMMUNICATION PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)
PSIL 113 123 121 118 113 125 126 123 119 90

ANNOYANCE PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)
PNLT C 2 0 1 0 1 1 1 1 1 1 1 1

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.
P ADDITIONAL EAR PROTECTION REQUIRED.